METHOD AND APPARATUS FOR PERFORMING MENISCUS REPAIR

FIELD

[0001] This invention relates generally to a method and apparatus for use in repairing soft tissue, and more particularly, to a method and apparatus for repairing a torn meniscus during arthroscopic surgery.

BACKGROUND

[0002] There are many techniques employed to repair damaged soft tissue. These techniques include suturing, stapling, taping and the like. Selection of which technique to employ depends upon the type of soft tissue being repaired, the soft tissue location and the required strength of the repair. While there exists many techniques to repair soft tissue, there is a growing need to easily and quickly repair a torn meniscus in the knee during arthroscopic surgery.

[0003] The meniscus tissue is a fibrocartilaginous structure in the knee joint which performs multiple critical functions, including contributing to normal knee biomechanics and the general well-being of the joint. Generally, the menisci are comprised of two C-shaped fibrocartilaginous structures residing on the tibial plateau. The peripheral rim of a meniscus is thick, tapering to a thin, free inner border. The superior surface is concave to contact the femoral condyles, while the inferior surface is flat to contact the tibial plateau. The fibers forming the menisci are mainly oriented circumferentially throughout the

meniscus, parallel to the peripheral border, to withstand hoop stresses placed upon the meniscus by the femoral condyles. It is generally recognized that repair of meniscal lesions, to the extent possible, is preferable to excision so as to attempt to maintain the normality of the meniscus and have it continue to function as intended.

[0004] One technique used to repair a torn meniscus is by means of suturing the tear by use of a suture and suture needle. One method of utilizing a suture and suture needle includes inserting the needles through the identified area and across the tear. Once the needles exit the knee joint they are pulled out and removed from the connected suture spanning between the needles. The suture is subsequently tied outside the tissue so that a horizontal suture extends in the meniscus. The process of tying the ends of a suture is time consuming and may result in an insufficient hold on the outside tissue.

[0005] Other techniques involve implanting surgical fasteners using an implanting device such as a spring gun. One disadvantage associated with utilizing a surgical fastener is the potential for the surgical fastener to migrate once it has been implanted which could potentially cause patient discomfort. Another disadvantage is that often only the tips of the fastener may be holding the tear together. What is needed then is a method and apparatus for repairing a torn meniscus which does not suffer from the above-mentioned disadvantages.

SUMMARY

[0006] A method of repairing a tear in body tissue includes inserting a needle containing a retaining head from a first insertion position on a first outer surface of the body tissue, through the tear and to a second outer surface of the body tissue. The retaining head is ejected from the insertion needle and grasps the second outer surface in an engaged position. An anchor coupled to the retaining head is advanced from a second insertion position on the first outer surface of the body tissue to a position at least through a portion of the tear. The anchor is coupled to the retaining head by a flexible member that extends a distance along the first outer surface of the body tissue from the first insertion position to the second insertion position.

[0007] According to other features, ejecting the retaining head from the insertion needle includes advancing a plunger within the needle toward a distal opening of the needle. The retaining head is deployed from the distal opening. The needle is removed from the body tissue at the first insertion position. Advancing the plunger includes guiding the flexible member along a longitudinal slot disposed along the needle. Advancing the anchor includes locating a distal end of a hollow tube on the second insertion position, the hollow tube containing the anchor therein. The plunger is advanced within the hollow tube a predetermined distance toward the distal end thereby advancing the anchor to a desired location.

[0008] An apparatus for repairing a tear in body tissue includes a retaining head for grasping a retaining surface of the body tissue and an anchor

for being implanted at a position at least through a portion of the tear. A flexible member is coupled to and extends between the retaining head and the anchor. The flexible member includes an intermediate portion extending along an insertion surface of the body tissue.

[0009] According to other features, the anchor is disposed in the body tissue at a location between the tear and the retaining surface and passes through the tear. The flexible member urges the anchor toward the insertion surface of the body tissue and urges the insertion surface of the tissue toward the anchor thereby urging opposite sides of the tear to contact. The flexible member urges the retaining head toward the insertion surface of the body tissue and urges the insertion surface of the tissue toward the retaining head thereby urging opposite sides of the tear to contact.

[0010] Further areas of applicability of the present disclosure will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and various examples, while indicating various embodiments of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the following claims.

BRIEF DESCRIPTION OF THE FIGURES

[0011] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0012] FIG. 1A is a perspective view of the meniscus repair apparatus according to the present teachings;

[0013] FIG. 1B is a front view of the implantation apparatus for use with the meniscus repair apparatus of FIG. 1A shown with the needle portion in section;

[0014] FIG. 2 is an environmental view of a human knee illustrating a tear in the meniscal tissue;

[0015] FIG. 3 is a perspective view of the needle portion of the insertion apparatus positioned at a first insertion position;

[0016] FIG. 4 is a perspective view of the needle portion shown advanced to an opposite outer surface of the meniscus prior to deployment of the retaining head;

[0017] FIG. 5 is a perspective view of the hollow tube portion positioned at the second insertion position;

[0018] FIG. 6 is a perspective view of the hollow tube shown after advancing the anchor to a desired location;

[0019] FIG. 7 illustrates the meniscus repair apparatus in an implanted position; and

[0020] FIG. 8 illustrates an implantation apparatus according to a various embodiment.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS

[0021] The following description of various embodiment(s) is merely exemplary in nature and is in no way intended to limit the application or uses.

[0022] With initial reference to FIG. 1A, an apparatus for repairing a tear in meniscal tissue is shown generally at reference 10. The apparatus 10 includes a suture 12 extending between an anchor 14 disposed on a first end 18 and a retaining head 22 disposed on a second end 24.

[0023] With continued reference to FIG. 1A and further reference to FIG. 1B, an insertion apparatus 30 for implanting the tissue repair apparatus 10 is shown. The insertion apparatus 30 generally includes a needle portion 32 and a hollow tube portion 36. Plungers 38 and 40 are slidaby received within the respective needle portion 32 and the tube portion 36. The needle portion 32 is tubular and presents a longitudinal passage 42 extending between a proximal end 44 and a distal end 48 for receiving the plunger 38. The distal end 48 is shaped to pierce the body tissue during implantation as will be described in greater detail. The proximal end 44 has a collar 50 radially arranged to encourage gripping by the user. A slot 54 is longitudinally arranged between the distal and proximal end 44 and 48 for accommodating the suture 12 during implantation.

[0024] The hollow tube portion 36 presents a longitudinal passage 58 extending between a proximal end 64 and a distal end 68. The plunger 40 is slidably received within a passage 58. A collar 70 is arranged on the proximal end 64 for encouraging gripping by the user. A slot 74 extends between the proximal end 64 and the distal end 68 for accommodating the suture 12 during implantation.

[0025] With particular reference to FIG. 1A, the tissue repair apparatus 10 will now be described in greater detail. The anchor 14 includes retaining members 78 disposed thereon for gripping surrounding tissue in an implanted position. Although the retaining members 78 are represented as contoured radial rings, those skilled in the art will recognize that any alternate structure conducive of providing a gripping action may be employed such as barbs, threads and the like. The anchor 14 may be insert molded onto the suture 12 during assembly or attached in any other appropriate manner. The suture 12 may comprise through holes formed at intervals thereon to allow resin to incorporate between the suture 12 and the anchor 14 during molding to prevent slipping. The retaining head 22 is tied or otherwise secured to the opposite end 24 of the suture 12. The retaining head 22 resembles a T-shaped member and is formed of rigid material such as stainless steel, aluminum or polypropylene. As shown in FIG. 1B, the retaining head 22 is movable into a substantially parallel relationship with the suture 12 to cooperate with the longitudinal passage 42 of the needle member 32.

[0026] Turning now to FIG. 2, a human knee is shown having a tear 80 in the meniscus 82. The tear 80 is defined by a first and second side 84 and 86 and is positioned in the meniscus 82 for illustrative purposes. In this way, it is appreciated that the tear 80 may be located in an alternative location along the meniscus 82. The meniscus 82 has a first and second outer surface 90 and 92. The first surface 90 defines an insertion surface and the second surface 92 defines a retaining surface. A first insertion location 94 is identified on the

second outer surface 92 as an exemplary location for penetrating the meniscal tissue 82 with the distal end 48 of the needle 32. Similarly, a second insertion location 96 is identified in an offset relationship from the first insertion location 94 for positioning the distal end 68 of the hollow tube 36 thereon.

[0027] FIGS. 3 – 7 illustrate the implantation of the tissue repair apparatus 10. With initial reference to FIGS. 3 and 4, insertion of the retaining head 22 will be described in greater detail. At the outset, the user positions the retaining head 22 within the longitudinal passage 42 of the needle 32. The suture 12 preferably lies proximate to the longitudinal slot 54 to allow the suture 12 to pass through if needed during assembly. At this time, the anchor 14, disposed on the opposite end 18 of the suture 12, may be free to move (FIG. 3), or alternatively, may be positioned within the hollow tube 36 (not shown). Once the first insertion position 94 is identified, the user penetrably advances the needle 32 from the insertion surface 92 through the tear 80 and to the retaining surface 90. As previously mentioned, the structure of the distal end 48 of the needle 32 is sharp to allow advancement through the meniscus 82.

[0028] Next, the plunger 38 is advanced through the longitudinal passage 42 in the needle 32 to deploy the retaining head 22 (FIG. 4). The retaining head 22 moves from a parallel relationship with the suture 12 while within the needle 32 to a transverse relationship with the suture 12 upon deployment. The needle 32 and plunger 38 are subsequently removed from the meniscus 82 and the retaining head 22 is positioned in a flush relationship with the retaining surface 90 (FIG. 5)

[0029] Referencing now FIGS. 5 – 7, implantation of the anchor 14 will be described. The anchor 14 is placed into the hollow tube member 36. Preferably the suture 12 is aligned proximate to the slot 74 to allow the suture 12 to fall through the slot 74 during insertion if desired. The hollow tube 36 is placed onto the second insertion position 96. The second insertion position 96 is chosen to provide an adequate distance from the first insertion position 94 for the suture 12 to span across after implantation. The distance between the first and second insertion position 94 and 96 defines a force distribution distance whereby the suture 12 spans across. Accordingly, the user can choose a distance to distribute the force generated at the suture 12 into the insertion surface 92 by the retaining head 22 and anchor 14 once implanted.

[0030] After the distal end 68 of the hollow tube 36 is placed over the second insertion position 96, the plunger 40 is slidably advanced toward the distal end 68 of the tube 36. The plunger 40 subsequently passes the anchor 14 through at least a portion of the tear 80. As shown in FIG. 6, the anchor 14 is advanced to a location between the tear 80 and the retaining surface 90. Preferably, the anchor 14 is advanced to a location whereby any slack in the suture 12 is removed. During advancement of the anchor 14 into the meniscus 82, the suture 12 passes through the slot 74. As the slack is removed in the suture 14, the first side of the tear 84 is urged toward the second side 86 thereby closing the tear 80. The hollow tube 36 is then removed from the insertion surface 92.

[0031] As shown in FIG. 7, the suture 12 defines a first portion 98, a second portion 100 and an intermediate portion 102 in an installed position. The first portion 98 extends from the retaining head 22 through the tear 80 and to the first insertion position 94. The second portion 100 extends from the anchor 14, through the tear 80 and to the second insertion position 96. The intermediate portion 102 extends along the insertion surface 92 between the first and second insertion position 94 and 96.

[0032] According to various features, an insertion apparatus 130 is shown in FIG. 8. The insertion apparatus 130 employs similar features as the insertion apparatus 30 as previously described and will be identified with like reference numerals. The insertion apparatus provides a needle 132 and a hollow tube 136 arranged in a fixed relationship. The insertion apparatus 130 allows the user to implant the retaining head 22 and the anchor 14 simultaneously. The distance between the first and second insertion position 94 and 96 is fixed by the structure of a cross brace 146. As shown in FIG. 8, the cross brace 146 is integral to the needle 132 and hollow tube 136. However, a plurality of removably fixed cross braces 146 may be provided for controlling a fixed distance for multiple applications. It is appreciated that plunger mechanism 138 may comprise separate plungers for advancing the retaining head 22 and the anchor 14 sequentially.

[0033] Those skilled in the art can now appreciate from the foregoing description that the broad teachings of the present invention can be implemented in a variety of forms. Therefore, while this invention has been described in

connection with particular examples thereof, the true scope of the invention should not be so limited since other modifications will become apparent to the skilled practitioner upon a study of the drawings, the specification and the following claims.